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FISH AS FOOD.

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BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., March 12, 1907.

Sir: I have the honor to transmit herewith an article on fish as food, prepared by C. F. Langworthy, of this Office, in accordance with instructions given by the Director. In this bulletin the attempt has been made to provide a useful summary of data regarding the nutritive value of fish and its place in the diet. The article is largely based on the investigations of Prof. W. O. Atwater, chief of the nutrition investigations of the Office of Experiment Stations, on the chemical composition and nutritive values of food fishes and aquatic invertebrates, the results of which were published in the reports of the United States Fish Commission for 1880, 1883, and 1888. Other publications of the Fish Commission, as well as reports of the New Jersey Experiment Stations, have been consulted, material from other authoritative sources has been incorporated, and the practical applications of scientific investigations regarding the food value of fish have been pointed out and illustrated. In preparing the present edition considerable new material has been added; the statistics of the fishery industry have, in so far as possible, been brought up to date; the tables and menus have been revised to include the results of analyses and experiments which have accumulated since the bulletin was first published, and a few other changes have been made which seemed desirable.

The publication of this article as a Farmers' Bulletin is respectfully recommended.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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FISH AS FOOD.

INTRODUCTION.

VALUE AND USE OF FISH.

As ordinarily used the term fish includes, besides the fish proper, many other water animals, as oysters, clams, and other mollusks; lobsters, crawfish, crabs, and shrimps, and turtle and terrapin. The term "sea food" is often used to cover the whole group, or, more particularly, salt-water food products as distinguished from those of fresh water.

Fish in one form or another is almost universally recognized as an important food material, and enters to some extent into the diet of very many if not the majority of American families. Few, however, have any adequate conception of the great importance of the fisheries of the United States and of the immense amount of nutritive material which is every year taken from the salt and fresh waters of this country.

From recent data collected by the United States Fish Commission it appears that more than 528,000,000 pounds of fish, crustaceans, etc., are annually taken from the waters of the New England States; over 819,000,000 pounds from the Middle Atlantic States; over 106,000,000 from the South Atlantic States; 113,000,000 from the Gulf States; 217,000,000 from the Pacific coast; 96,000,000 from the Mississippi River and its tributaries, and 166,000,000 pounds from Alaska. The products of the fisheries of the Great Lakes exceed 113,000,000 pounds annually, and of the minor interior waters 5,000,000 pounds. In addition, thousands of pounds of fish are annually caught by sportsmen, but statistics of the amount are not available. In the case of the coast sections the statistics given above include only the coast fisheries. The interior fisheries of Vermont are included with those of New England, the fisheries of New York and Pennsylvania on the Great Lakes with those of the Middle Atlantic States, and the fisheries of the east coast of Florida with those of the Gulf States. The data for the Great Lakes embrace only those States not having coast fisheries, but include the fisheries of the Ohio River for Ohio, Indiana, and Illinois. The figures for the interior States are confined to States not having coast or Great Lake fisheries. In all sections the data represent the products as they leave the hands of the fishermen, except that in the

case of Alaska the figures include salmon after being canned or otherwise prepared for the market. In considering such products as clams, scallops, and oysters the weight of the edible portion only has been taken into account.

The total weight of the fish products of the United States as they leave the hands of the fishermen is about 2,169,000,000 pounds, representing in round numbers as the value of the catch $58,000,000. By the processes of canning, salting, smoking, and otherwise preserving, the value of the fish is very much increased.

Of the very large quantity of fish annually placed on the American market, the greater part is consumed at home, although a portion is prepared in various ways for export.

The preference for fresh-water or salt-water fish is a matter of individual taste. Both are, so far as known, equally wholesome. Indeed, it may be said that in general the preference for one kind of sea food or another is quite largely a matter of circumstances. It is noticeable that many kinds of fish which are known to be good for food are seldom eaten. Among others may be mentioned the whiting, or silver hake, and the sea robin. The latter are taken in enormous quantities in certain regions. This prejudice against certain fish is largely local; for instance, skates are eaten on the western coast of the United States, but until recently they were regarded as of no value in the East. A few years ago sturgeon and eel were not generally eaten. To-day sturgeon is much prized, and in regions where it was formerly worthless commands a high price. Many persons have a prejudice against frogs' legs, while others consider them a great delicacy. In the United States they are now very commonly eaten, and frog raising for the market is more or less of an industry. It is doubtful if Americans ever eat any portion except the legs of frogs, yet in many regions of Europe the bodies are also used. In Cuba and other localities squid tentacles are eaten, and are undoubtedly palatable when well prepared. An interesting change of opinion regarding the use of a sea product may be noted in the case of abalone, a large mollusk abundant on the California coast, which was formerly disregarded as a food product by Americans, but which, it is said, owing to its use by the Chinese, has become known and is relished.

CONDITIONS WHICH AFFECT THE MARKET VALUE OF FISH.

The market value of fish is affected by various conditions. Among these are the locality from which they come, the season in which they are taken, and the food on which they have grown. In general, it may be said that fish from clear, cold, or deep water are regarded as preferable to those from shallow or warm water, while fish taken in

waters with a rocky or sandy bottom are preferable to those from water with a muddy bottom. Some fish, for instance shad, are at their best during the spawning season, while others should not be eaten during this period. Those fish which feed on small crustacea and the other forms of animal and vegetable life, constituting their natural food, are preferable to those living upon sewage and other matter which may contaminate the waters. (See p. 32.)

The mode of capture also affects the market value. Fish caught by the gills and allowed to die in the water by slow degrees, as is the case where gill nets are used, undergo decomposition very readily and are inferior for food. Fish are often landed alive and allowed to die slowly. This custom is not only inhumane, but lessens the value of the fish. It has been found that fish killed immediately after catching remain firm and bear shipment better than those allowed to die slowly. The quality of the fish is often injured by improper handling in the fishing boats before placing on the market. Improvements in transportation facilities and in other lines have made it possible to bring fish to market from distant fishing grounds in good condition.

Fresh-water and salt-water fish alike are offered for sale as taken from the water, and preserved in a number of ways. In some cases preservation is only to insure transportation to remote points in good condition. Low temperature is the means most commonly employed for this purpose. By taking advantage of the recent improvements in apparatus and methods of chilling and freezing, fish may be shipped long distances and kept a long time in good condition. Some of the dangers from eating fish which is not in good condition are pointed out on page 30.

The preservation of meat or fish by methods of cold storage has developed very greatly within recent years and has grown to be a very important industry. The process depends for its success quite largely upon the fact that the activity of micro-organisms, which cause putrefactive and other changes in food products, is lessened by cold. In addition to micro-organisms which are almost inevitably present, being found everywhere—in the air, in water, etc.—fish, like other meats, normally contain ferments which cause changes in composition and flavor comparable in some ways with those caused by micro-organisms, though they differ in important respects. From recent investigations along these lines, the conclusion was reached that when meat is stored at the freezing point of water (32° F.) the activity of micro-organisms is checked, but the action of ferments normally present in the meat still continues, and it ripens, though it does not decay. Such stored meat was regarded as especially suited for roasting or broiling, though not as good as fresh meat for boiling. On the other hand, the conclusion was reached that fish can not be

satisfactorily preserved at 32° F., since this temperature is not sufficient to hinder the action of the ferments present in the fish flesh, though it checks the action of micro-organisms. The ferments acting upon the tissues in which they occur produce bodies of unpleasant flavor and the fish becomes unpalatable, though it is not in any sense decayed. To successfully hinder the action of the ferments a temperature lower than 32° F. is needed. These facts are in accord with the common practice of shipping fish frozen.

It is stated on good authority that in commercial practice 25° F. is regarded as the proper temperature for storing fish which has been previously frozen. For dried fish the proper temperature is 25° F., for fresh fish 25 to 30° F., for oysters 33 to 40° F., for oysters in the shell 40° F., and for oysters in the tub 35° F. Oysters should not be frozen. It is claimed that oysters may be safely kept for six weeks at a temperature of 40° F., and an instance is recorded in which they were kept ten weeks at this temperature for experimental purposes.

According to the practice of a successful firm dealing in frozen fish, the fish, as they are unloaded from the boats, are sorted and graded as to size and quality, then placed in galvanized iron pans about 2 feet long, covered with loosely fitting lids, and frozen by keeping them twenty-four hours at a temperature often as low as 16° below zero. The fish are removed from the pans in a solid cake and packed in tiers in the storehouse and marketed frozen. It is said that they may be thus preserved indefinitely, though as a rule frozen fish are only kept six to eight months, being frozen in the spring, when the supply is abundant, and sold in the winter or whenever fresh fish can not be readily obtained. Such frozen fish are commonly shipped in barrels packed with broken ice in such a manner that the water formed by the melting ice may readily escape.

The flavor of oysters is affected more or less by the locality in which they have grown, those from certain regions being regarded as of very superior quality. The season of the year affects the market value of oysters, although it is noticeable that as methods of transportation and preservation improve, the oyster season becomes longer. This may also be said of lobsters, crabs, etc. Extended investigations, including the conditions affecting the growth and food value of oysters, their parasites and diseases, etc., have been carried on by the New Jersey Experiment Stations. These investigations have shown that oysters rapidly deteriorate when removed from the water, through the fermentative action of bacteria; and that oysters in spawn deteriorate more rapidly than at any other season at the same temperature. However, oysters which are ready to spawn are considered especially palatable if cooked soon after removal from the sea bed.

PREPARING FISH FOR MARKET.

Fish are sold either "round," i. e., whole, or dressed. Sometimes only the entrails are removed. Often, however, especially when dressed for cooking, the head, fins, and, less frequently, the bones are removed. This entails a considerable loss in weight as well as of nutritive material. It has been assumed that in dressing fish the following percentages are lost: Large-mouthed black bass, sea bass, cisco, kingfish, mullet, white perch, pickerel, pike, tomcod, weakfish, and whitefish, each 17.5 per cent; small-mouthed black bass, eel, Spanish mackerel, porgy, and turbot, each, 13.5 per cent; butter-fish, 12.5 per cent; shad, 11 per cent; and brook trout, 16.5 per cent. More recent figures for loss in weight in dressing are as follows: Bullhead, 50 per cent; buffalo-fish and lake sturgeon, 40 per cent; carp and sucker, 35 per cent; fresh-water sheepshead, 23 per cent; grass pike, black bass, white bass, yellow perch, and salmon, 15 per cent, and eels, 10 per cent.

Large quantities of fish are dried, salted, and smoked, the processes being employed alone or in combination. These methods insure preservation, but at the same time modify the flavor. Several fish products are also prepared by one or more of these processes. Caviar, which may be cited as an example, is usually prepared from sturgeon roe by salting. The methods of salting and packing vary somewhat and give rise to a number of varieties. Although formerly prepared almost exclusively in Russia, caviar is now made to a large extent in the United States. In methods of drying fish the Chinese are very expert, producing, among other goods, dried oysters, which are said to be palatable and of good quality. Dried fish and fish products are also important in the diet of the Japanese.

When fish are salted and cured there is a considerable loss in weight, due to removal of the entrails, drying, etc. Codfish lose 60 per cent in preparation for market. If the market-dried fish is boned there is a further loss of 20 per cent. The loss in weight of pollock from the round to the market-dried fish is 60 per cent; haddock, 62 per cent; hake, 56 per cent; and cusk, 51 per cent.

The Scandinavians make a number of fish products in which the fish is allowed to ferment, the methods followed being in a way comparable with those employed in the manufacture of sauerkraut. In Java the natives are very partial to fish which has undergone fermentation, sometimes apparently putrefactive and resulting in a product which would be considered entirely unfit for food from a western standpoint.

The canning industry has been enormously developed in recent years and thousands of pounds of fish, oysters, lobsters, etc., are annually preserved in this way. In canning, the fish or other material is heated (the air being sometimes exhausted also) to destroy micro-organisms,

and sealed to prevent access of air, which would introduce micro-organisms as well as oxygen. Thus the canned material is preserved from oxidation and decomposition. The processes of canning have been much improved, so that the original flavor is largely retained, while the goods may be kept for an indefinite period. Fish, as well as meat, is usually canned in its own juice or cooked in some form, though sardines and some other fishes are commonly preserved in oil.

Various kinds of fish extract, clam juice, etc., are offered for sale. These are similar in form to meat extract. There are also a number of fish pastes and similar products—anchovy paste, for instance—which are used as relishes or condiments.

Preservatives such as salicylate of soda are employed to some extent in marketing fish and especially oysters. The extended use of such materials is not desirable since some of them are justly regarded as harmful.

Oysters and other shellfish are placed on the market alive in the shell or are removed from the shell and kept in good condition by chilling or other means. Oysters in the shell are usually transported in barrels or sacks. Shipment is made to far inland points in refrigerator cars and to Europe in the cold-storage chambers of vessels. Large quantities of shellfish are also canned. Oysters are often sold as they are taken from the salt water. However, the practice of "freshening," "fattening," or "floating" is very widespread—that is, oysters are placed in fresh or brackish water for a short period. They become plump in appearance and have a different flavor from those taken directly from salt water (see p. 15). As noted on page 32, care should be taken that the oysters are grown and fattened in water which is not contaminated by sewage.

Lobsters, crabs, and other crustacea are usually sold alive. Sometimes they are boiled before they are placed on the market. Large quantities of lobsters, shrimps, and crabs are canned.

Turtle and terrapin are usually marketed alive. Turtle soup, however, is canned in large quantities. Frogs are marketed alive or dressed, and may be eaten at all seasons, but are in the best condition in the fall or winter. It is said that Minnesota is the center of the frog industry in the United States, the catch for a year being about 5,000,000 frogs, or not far from 500,000 dozen pairs of frogs' legs, the annual value of the frog business being upward of $100,000.

NUTRITIVE VALUE OF FISH.

COMPOSITION OF FISH.

Fish contain the same kinds of nutrients as other food materials. In general it may be said that food (fish, meat, cereals, vegetables, etc.) serves a twofold purpose: It supplies the body with material for build-

ing and repairing its tissues and fluids, and furnishes it with fuel for maintaining body temperature and for supplying the energy necessary for muscular work.

In a way the body is like a machine, with food for its source of motive power. The body differs from a machine, however, in that the fuel, i. e., food, is used to build it as well as supply it with energy. Further, if the body is supplied with more food than is needed, the excess can be stored as reserve material, usually in the form of fat. In the furnace, fuel is burned quickly, yielding heat and certain chemical products—carbon dioxid, water vapor, and nitrogen. In the body the combustion takes place much more slowly, but in general the final products are the same. The combustion of nitrogen is, however, not so complete as in a furnace. Due allowance is made for this fact in calculations involving the question of the energy which food will furnish.

Food consists of an edible portion and refuse, i. e., bones of fish and meat, shells of oysters, bran of wheat, etc. Although foods are so different in appearance, chemical analysis shows that they are all made up of a comparatively small number of chemical compounds. These are water and the so-called nutrients, protein or nitrogenous materials, fat, carbohydrates, and ash or mineral matter. Familiar examples of protein are lean of fish and meat, white of egg, casein of milk (and cheese), and gluten of wheat. Fat is found in fat fish and meat, in lard, fat of milk (butter), and oils, such as olive oil. Starches, sugars, and woody fiber or cellulose form the bulk of the carbohydrates. Certain carbohydrates are found in meat and fish, although the amount is not large. The protein, fats, and carbohydrates are all organic substances—that is, they can be burned with the formation of various gases, chiefly carbon dioxid and water, leaving no solid residue. The mineral matters will not burn, and are left behind when organic matter is ignited. By analysis the nutrients have been found to be made up of a comparatively small number of chemical elements in varying combinations. These are nitrogen, carbon, oxygen, hydrogen, phosphorus, sulphur, calcium, magnesium, sodium, potassium, silicon, chlorin, fluorin, and iron. Doubtless no single nutrient contains all these elements. The body tissues and fluids contain nitrogen; and hence protein, which alone supplies nitrogen to the body, is a necessary factor in food. All the nutrients except mineral matter contain carbon, oxygen, and hydrogen, and can supply them to the body. Protein, fat, and carbohydrates are all sources of energy.

The value of a food as a source of material for building and repairing the body is shown by its chemical composition—that is, by the amount of digestible nutrients which it contains. Some other means are necessary to show its value as a source of energy. It is known

that all energy may be measured in terms of heat. In order to have some measure for expressing the amount of heat the calorie is taken as a unit. Roughly speaking, this is the amount of heat required to raise the temperature of 1 pound of water 4° F. One pound of starch would, if burned and all the heat utilized, raise 1,900 pounds of water 4° in temperature; or it would raise 5 gallons of water from the freezing point to the boiling point, but would not cause it to boil.

The number of calories which different foods will supply may be determined by burning them in an apparatus called a calorimeter, or by taking the sum of the calories which it is calculated the protein, fat, and carbohydrates making up the food would furnish. It has been found by experiment that the fuel value of a pound of protein as ordinarily burned in the body is 1,860 calories; the fuel value of a pound of carbohydrates is the same, while that of a pound of fat is 2.25 times as great.

The value of a food is usually judged by several different standards. Thus it must be digestible and palatable, furnish the nutrients needed by the system in proper amounts, and be reasonably cheap.

The relative nutritive value of any food may be learned by comparing its composition and energy value with similar data for other foods. Table 1 shows the composition of a number of food fishes, fresh and preserved in a variety of ways; oysters, clams, and other mollusks; lobsters, shrimps, crawfish, and crabs; turtle and terrapin, and frogs' legs. For purposes of comparison the analyses of a number of kinds of meat, vegetables, and other common food materials, are included.

In several cases the analysis of fish, whole and dressed, is given. Usually the composition of the dressed fish was computed from that of whole fish with the aid of the figures for loss of weight in dressing for market, mentioned on page 7.

TABLE 1.—*Composition of fish, mollusks, crustaceans, etc*

Kind of food material.	Refuse (bone, skin, etc.).	Salt.	Water.	Protein by factor (N× 6.25).	Fat.	Carbohydrates.	Ash or mineral matter.	Total nutrients.	Fuel value per pound.
FRESH FISH.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Alewife, whole	49.5	......	37.6	9.8	2.4	......	0.8	13.0	277
Bass, large-mouthed black, dressed	46.7	......	41.9	10.3	.5	......	.6	11.4	209
Bass, large-mouthed black, whole	56.0	......	34.6	8.5	.4	......	.5	9.4	172
Bass, small-mouthed black, dressed	46.4	......	40.1	11.7	1.3	......	.7	13.7	263
Bass, small-mouthed black, whole	53.6	......	34.7	10.1	1.1	......	.6	11.8	227
Bass, sea, dressed	46.8	......	42.2	10.5	.2	......	.7	11.4	200
Bass, sea, whole	56.1	......	34.8	8.7	.2	......	.6	9.5	168
Bass, striped, dressed	51.2	......	37.4	8.8	2.2	......	.5	11.5	249
Blackfish, dressed	55.7	......	35.0	8.4	.5	......	.5	9.4	172
Bluefish, dressed	48.6	......	40.3	10.0	.6	......	.7	11.3	204
Butterfish, dressed	34.6	......	45.8	11.8	7.2	......	.7	19.7	503
Butterfish, whole	42.8	......	40.1	10.3	6.3	......	.6	17.2	440
Carp (European analysis)	37.1	......	48.4	....	.7	......	.9	14.5	263

TABLE 1.—*Composition of fish, mollusks, crustaceans, etc.*—Continued.

Kind of food material.	Refuse (bone, skin, etc.).	Salt.	Water.	Protein by factor (N× 6.25).	Fat.	Carbo-hydrates.	Ash or mineral matter.	Total nutrients.	Fuel value per pound.
FRESH FISH—continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Cod, dressed	29.9	......	58.5	11.1	0.2	......	0.8	12.1	209
Cod, steaks	9.2	......	72.4	17.0	.5	......	1.0	18.5	327
Cusk, dressed	40.3	......	49.0	10.1	.1	......	.5	10.7	186
Eel, salt-water, dressed	20.2	......	57.2	14.8	7.2	......	.8	22.8	558
Flounder, common, dressed	57.0	......	35.8	6.4	.3	......	.6	7.3	127
Flounder, winter, dressed	56.2	......	37.0	6.3	.2	......	.5	7.0	122
Hake, dressed	52.2	......	39.5	7.3	.3	......	.5	8.1	145
Haddock, dressed	51.0	......	40.0	8.4	.2	......	.6	9.2	159
Halibut, dressed	17.7	......	61.9	15.3	4.4	......	.9	20.6	454
Herring, whole	42.6	......	41.7	11.2	3.9	......	.9	16.0	363
Mackerel, dressed	40.7	......	43.7	11.6	3.5	......	.7	15.8	354
Mackerel, Spanish, dressed	24.4	......	51.4	16.3	7.2	......	1.2	24.7	585
Mackerel, Spanish, whole	34.6	......	44.5	14.1	6.2	......	1.0	21.3	508
Mullet, dressed	49.0	......	38.2	9.9	2.4	......	.6	12.9	277
Mullet, whole	57.9	......	31.5	8.2	2.0	......	.5	8.9	231
Perch, white, dressed	54.6	......	34.4	8.8	1.8	......	.5	11.1	231
Perch, white, whole	62.5	......	28.4	7.3	1.5	......	.4	9.2	195
Perch, yellow, dressed	35.1	......	50.7	12.8	.7	......	.9	14.4	259
Pickerel, dressed	35.9	......	51.2	12.0	.2	......	.7	12.9	227
Pickerel, whole	47.1	......	42.2	9.9	.2	......	.6	10.7	186
Pollock, dressed	28.5	......	54.3	15.4	.6	......	1.1	17.1	304
Pompano, whole	45.5	......	39.5	10.3	4.3	......	.5	15.1	358
Porgy, dressed	53.7	......	34.6	8.6	2.4	......	.7	11.7	254
Porgy, whole	60.0	......	29.9	7.4	2.1	......	.6	10.1	218
Red grouper, dressed	55.9	......	35.0	8.5	.2	......	.5	9.2	163
Red snapper, dressed	45.3	......	43.7	10.6	.3	......	.7	11.6	204
Salmon, California (sections)	10.3	......	57.9	16.7	14.8	......	.9	32.4	903
Salmon, Maine, dressed	23.8	......	51.2	15.0	9.5	......	.9	25.4	658
Shad, dressed	43.9	......	39.6	10.6	5.4	......	.8	16.8	408
Shad, whole	50.1	......	35.2	9.4	4.8	......	.7	14.9	363
Shad, roe	......	......	71.2	23.5	3.8	......	1.5	28.8	581
Smelt, whole	41.9	......	46.1	10.1	1.0	......	1.0	12.1	222
Sturgeon, dressed	14.4	......	67.4	15.1	1.6	......	1.2	17.9	340
Tomcod, dressed	51.4	......	39.6	8.4	.3	......	.5	9.2	163
Tomcod, whole	59.9	......	32.7	6.9	.2	......	.4	7.5	132
Trout, brook, dressed	37.9	......	48.4	11.9	1.3	......	.7	13.9	268
Trout, brook, whole	48.1	......	40.4	9.9	1.1	......	.6	11.6	222
Trout, lake, dressed	37.5	......	44.4	11.0	6.2	......	.7	17.9	449
Turbot, dressed	39.5	......	43.1	8.9	8.7	......	.8	18.4	513
Turbot, whole	47.7	......	37.3	7.7	7.5	......	.7	15.9	445
Weakfish, dressed	41.7	......	46.1	10.4	1.3	......	.7	12.4	240
Weakfish, whole	51.9	......	38.0	8.6	1.1	......	.6	10.3	200
Whitefish, dressed	43.6	......	39.4	12.8	3.6	......	.9	17.3	376
Whitefish, whole	53.5	......	32.5	10.6	3.0	......	.7	14.3	313
General average of fresh fish as sold	41.6	......	44.6	10.9	2.4	......	.7	14.0	295
PRESERVED FISH.									
Mackerel, No. 1, salted	19.7	8.3	34.8	13.9	21.2	......	2.1	37.2	1,107
Cod, salted and dried	24.9	17.3	40.2	19.0	.4	......	1.2	20.6	363
Cod, boneless codfish, salted and dried	......	21.5	54.4	26.3	.3	......	1.7	28.3	490
Caviar	......	......	38.1	30.0	19.7	7.6	a4.6	61.9	1,479
Herring, salted, smoked, and dried	44.4	6.5	19.2	20.5	8.8	......	.9	30.2	726
Haddock, salted, smoked, and dried	32.2	1.4	49.2	15.8	.1	......	1.0	16.9	290
Halibut, salted, smoked, and dried	7.0	12.0	46.0	19.3	14.0	......	1.9	35.2	916
Sardines, canned	5.0	......	53.6	23.7	12.1	......	5.3	41.1	916
Salmon, canned	14.2	......	56.8	19.5	7.5	......	a2.0	29.0	658
Mackerel, canned	......	1.9	68.2	19.6	8.7	......	1.3	29.6	708
Mackerel, salt, canned	19.7	8.3	34.8	13.9	21.2	......	2.1	37.2	1,107
Tunny, canned	......	......	72.7	21.7	4.1	......	1.7	27.5	558
Haddock, smoked, cooked, canned	......	5.6	68.7	22.3	2.3	......	1.6	26.2	499
MOLLUSKS.									
Oysters, solids	......	......	88.3	6.0	1.3	3.3	1.1	11.7	222
Oysters, in shell	81.4	......	16.1	1.2	.2	.7	.4	2.5	41
Oysters, canned	......	......	83.4	8.8	2.4	3.9	1.5	16.6	327
Scallops	......	......	80.3	14.8	.1	3.4	1.4	19.7	336
Long clams, in shell	41.9	......	49.9	5.0	.6	1.1	1.5	8.2	136
Long clams, canned	......	......	84.5	9.0	1.3	2.9	2.3	15.5	268

a Including salt.

TABLE 1.—*Composition of fish, mollusks, crustaceans, etc.*—Continued.

Kind of food material.	Refuse (bone, skin, etc.).	Salt.	Water.	Protein by factor (N× 6.25).	Fat.	Carbohydrates.	Ash or mineral matter.	Total nutrients.	Fuel value per pound.
MOLLUSKS—continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Round clams, removed from shell	......	......	80.8	10.6	1.1	5.2	2.3	19.2	331
Round clams, in shell	67.5	......	28.0	2.1	.1	1.4	.9	4.5	68
Round clams, canned	......	......	82.9	10.5	.8	3.0	2.8	17.1	277
Mussels	46.7	......	44.9	4.6	.6	2.2	1.0	8.4	150
General average of mollusks (exclusive of canned)	59.4	......	34.7	3.2	.4	1.4	.9	5.9	99
CRUSTACEANS.									
Lobster, in shell	61.7	......	30.7	5.9	.7	.2	.8	7.6	141
Lobster, canned	......	......	77.8	18.1	1.1	.5	2.5	22.2	381
Crawfish, in shell	86.6	......	10.9	2.1	.1	.1	.2	2.5	45
Crabs, in shell	52.4	......	36.7	7.9	.9	.6	1.5	10.9	191
Crabs, canned	......	......	80.0	15.8	1.5	.7	2.0	20.0	358
Shrimp, canned	......	......	70.8	25.4	1.0	.2	2.6	29.2	503
Fresh abalone	......	......	72.8	22.2	.3	3.3	1.4	27.2	501
Canned abalone, flesh	......	......	73.2	21.7	.1	3.7	1.3	26.8	489
Canned abalone, liquid in can	......	......	93.8	4.4	.1	.2	1.5	6.2	93
Dried abalone	......	......	39.7	36.0	.5	20.9	2.9	60.3	1,079
General average of crustaceans (exclusive of canned and dried)	50.2	......	37.8	9.5	.5	1.0	1.0	12.0	220
TERRAPIN, TURTLE, ETC.									
Terrapin, in shell	75.4	......	18.3	5.2	.9	......	.2	6.3	132
Green turtle, in shell	76.0	......	19.2	4.7	.1	......	.3	5.1	91
Average of turtle and terrapin	75.6	......	18.8	4.9	.5	......	.3	5.7	111
Frogs' legs	32.0	......	56.9	10.5	.1	......	.7	11.3	195
General average of fish, mollusks, crustaceans, etc	45.0	......	42.3	9.7	2.1	.2	.7	12.7	264
OTHER ANIMAL FOODS.									
Beef, side, medium fat	17.4	......	49.4	14.8	18.1	......	.7	33.6	998
Veal, side	22.6	......	55.2	15.6	6.3	......	.8	22.7	535
Mutton, side	19.3	......	43.3	13.0	24.0	......	.7	37.7	1,207
Average of beef, veal, and mutton	19.4	......	49.3	14.5	16.1	......	.7	31.3	913
Pork, side	11.2	......	26.1	8.3	54.8	......	.4	63.5	2,363
Chicken	25.9	......	47.1	13.7	12.3	......	.7	26.7	744
Turkey	22.7	......	42.4	16.1	18.4	......	.8	35.3	1,034
Milk	......	......	87.0	3.3	4.0	5.0	.7	13.0	313
VEGETABLE FOODS.									
Wheat flour	......	......	12.0	11.4	1.0	75.1	.5	88.0	1,610
Corn meal	......	......	12.5	9.2	1.9	75.4	1.0	87.5	1,610
Wheat bread (from patent flour)	......	......	35.3	9.2	1.3	53.1	1.1	64.7	1,215
Beans, dried	......	......	12.6	22.5	1.8	59.6	3.5	87.4	1,560
Potato	20.0	......	62.6	1.8	.1	14.7	.8	17.4	303
Cabbage	15.0	......	77.7	1.4	.2	4.8	.9	7.3	122
Corn, canned	......	......	76.1	2.8	1.2	19.0	.9	23.9	445
Salad greens	......	......	86.7	4.2	.6	6.3	2.2	13.3	213
Apples	25.0	......	63.3	.3	.3	10.8	.3	11.7	213
Bananas	35.0	......	48.9	.8	.4	14.3	.6	16.1	290
Strawberries	5.0	......	85.9	.9	.6	7.0	.6	9.1	168
Sugar	......	......	......	......	......	100.0	......	100.0	1,860

The above list includes the more important food fishes, water invertebrates, etc. There are numbers of other fish which are eaten to a greater or less extent. In general it may be said their composition would be similar to that of the fishes included in the table.

In a number of cases cited in the table above more than one specimen was analyzed, although only the averages are given in the table. In such cases the samples showed more or less variation in total nutri-

ents, but the variation was due more especially to the fats. Thus the fat in the flesh of seven specimens of shad ranged from 6.5 to 13.6 per cent; in fresh mackerel from 2.2 to 16.3 per cent, and in fresh halibut from 2.2 to 10.6 per cent. The protein and ash or mineral matter remained practically the same in all the specimens where the wide fat variation was noticeable, an increase of fat being accompanied by a decrease of water.

An extended study of the chemical composition of fish was recently carried on at the zoological station at Naples by Lichtenfelt. It was found that the composition of the muscular tissue changes periodically with age, nutrition, and reproduction. Under the influence of hunger the amount of water in the flesh is increased and the proportion of solids diminished. The richer the muscles in fat, the greater the loss as compared with lean fish. The amount of protein is also diminished not only in salmon, but in other sorts of fish. The amount of insoluble proteids is decreased while the proportion of soluble proteids may be either increased or lowered according to circumstances. Muscular activity in connection with hunger seems a condition especially suited to induce an increase of soluble proteids in fish flesh.

It will be seen from the table that fish is essentially a nitrogenous food. In this it resembles meat. Neither fish nor meat is a source of carbohydrates. Oysters and other shellfish contain some carbohydrates, but the foods which supply this group of nutrients most abundantly are sugar and the cereal grains. The place of fish in the diet, if judged by its composition, is therefore the same as that of meat—that is, it supplements cereals and other vegetables, the most of which, as wheat, rye, maize, rice, potatoes, etc., are deficient in protein, the chief nutrient in the flesh of fish. As regards the relative nutritive value of meat and fish, Atwater's conclusion, from a large number of investigations, was that the only considerable difference is in the proportion of water and fat present, the flesh of the fish having water where meat has fat.

From the standpoint of both nutritive value and palatability fish, according to a recent German investigator, is an important food product and, as shown by his experiments, equal to beef as a source of energy in the diet. It produces the same sensation of satiety and this persists for as long a time. It was found that fish caused the excretion of a smaller amount of uric acid than meat.

In general, it may be said that fish, meat, eggs, milk, etc., also cereals and vegetable foods, all supply fat, the amount varying in the different materials. Fish usually contains less fat than is found in meat. There is, however, much difference in the fat content of the various kinds of fish. They may, indeed, be roughly divided into three classes: The first class would include those containing over 5 per cent fat; the second, those containing between 2 and 5 per cent, and the third, those con-

taining less than 2 per cent. The first group would include such fish as salmon, shad, herring, Spanish mackerel, and butter-fish; the second, whitefish, mackerel, mullet, halibut, and porgy; the third, smelt, black bass, bluefish, white perch, weakfish, brook trout, hake, flounder, yellow perch, pike, pickerel, sea bass, cod, and haddock.

As regards nitrogenous constituents, fish flesh contains more gelatin-yielding material (collagen) and less extractive material (meat bases) than meat. As is well known, the characteristic red color of blood and muscular tissue is due to the presence of a substance called hemoglobin. The flesh and blood of fish contain less of this and allied coloring matters than meat, which accounts for the light color commonly observed in fish flesh. The flesh of some fishes, like salmon, has a decided color. It is not due, however, to hemoglobin, but to the presence of a special pigment.

The so-called nitrogenous extractives ("meat extract"), contained in small quantities in fish as in other animal foods, are doubtless useful in nutrition, although opinions have differed as to their real function. Recent investigations indicate very strongly that flesh extractives play an important part in stomach digestion, as they have been shown to induce an abundant flow of normal gastric juice. Many of the ordinary food materials possess this property also, but the flesh extractives seem to be especially suited to the purpose. They do not, it is true, furnish the body much food material, but they are nevertheless important if they normally help it to digest other foods.

With the exception of a few kinds which are preserved whole, preserved fish, as a rule, show a small percentage of refuse. The percentage of actual nutrients is much larger than in the corresponding fresh fish, owing to the removal of a large part of the refuse and more or less water. The gain in nutrients is mostly represented by protein, which is the most valuable nutrient.

Dried fish is richer in nutritive material, pound for pound, than fresh fish, since it has been concentrated by evaporation. It has been found that the average loss in weight in drying is about 30 per cent, or less than the average values for different kinds of meat. The loss in weight is chiefly due to the evaporation of water, though in some cases dried fish contains a little less ether extract than fresh fish.

When foods are cooked there is, generally speaking, a loss of weight owing to the evaporation of water, and in the ordinary methods of cooking fish and meat some nutritive material is lost also. In recent experiments it was found that the water in which fish was boiled contained 9 to 11 per cent of the total fish protein.

Canned fish, which is in effect cooked fish, compares favorably as regards composition with the fresh material. Generally speaking, the amount of refuse is small, since the portions commonly rejected in preparation for the table have been removed before canning.

The various kinds of shellfish resemble meat and food fishes in general composition. They contain, however, an appreciable amount of carbohydrates. Oysters are the most important of the shellfish, judging by the relative amount consumed. Speaking roughly, a quart of oysters contains on an average about the same quantity of actual nutritive substance as a quart of milk, or three-fourths of a pound of beef, or 2 pounds of fresh codfish, or a pound of bread; but, while the weight of actual nutriment in the different quantities of food materials named is very nearly the same, the kind is widely different. That of the lean meat or codfish consists mostly of protein, the substance whose principal function is to make or repair blood, muscle, tendon, bone, brain, and other nitrogenous tissues. That of bread contains considerable protein, but a much larger proportion of starch, with a little fat and other compounds which supply the body with heat and muscular power. The nutritive substance of oysters contains considerable protein and energy-yielding ingredients. Oysters come nearer to milk than almost any other common food material as regards both the amounts and the relative proportions of nutrients.

Apparently as the oyster grows older, at least up to a certain time, not only do the proportions of flesh and liquids increase more rapidly than the shells, but the proportion of nutrients in the edible portion increases also; that is to say, 100 pounds of young oysters in the shell appear to contain less of flesh and of liquids than 100 pounds of older ones, and when both have been shucked a pound of shell contents from the older oysters would contain more nutriment than a pound from the younger.

Considering the edible portion of the oyster, after it has been removed from the shell, the differences in different specimens are much greater than is commonly supposed. This is apparent when a comparison is made of either the flesh (meat) or liquids (liquor) of different specimens, or the whole edible portion, the meat (solids) and liquor together. The percentage of water in the edible portion of different specimens of oysters which were analyzed in experiments conducted for the U. S. Fish Commission varied from about 83.4 to 91.4 per cent, and averaged 87.3 per cent. This makes the amounts of "water-free substance," i. e., actually nutritive ingredients, vary from 16.6 to 8.6 and average 12.7 per cent of the whole weight of the edible portion (shell contents) of the animals. In other words, the nutritive material in a quart (about 2 pounds) of shell contents (solids) varied from 2.75 to 5.33 ounces.

With oysters, long clams, and round clams in the shell there is naturally a large percentage of waste, as the shell constitutes a large proportion of the total weight. The average of 34 specimens of oysters in the shell, for instance, shows only 2.3 per cent of actual nutrients. Clams and mussels show a somewhat higher percentage.

Where these various shellfish are purchased as "solids"—that is,

removed from the shell—a comparatively high price is usually paid. Where they are purchased in the shell, there is a very large percentage of waste. The conclusion is therefore warranted that, from a pecuniary standpoint, they are not the most economical of foods for the consumer. On the other hand, they have a useful place in the diet in helping to supply the variety which is apparently needed to insure the best workings of the digestive system. Often flavor has a value which can not be estimated in dollars and cents.

As already explained, it is a common practice of oyster dealers, instead of selling the oysters in the condition in which they are taken from the beds in salt water, to place them for a time—forty-eight hours, more or less—in fresh or brackish water, in order, as the oystermen say, to "fatten" them, the operation being also called "floating" or "laying out." By this process the oyster acquires plumpness and rotundity, and its bulk and weight are so increased as materially to increase its selling value. The belief is common among oystermen that this "fattening" is due to actual gain of flesh and fat, and that the nutritive value of the oyster is increased by the process. They find that the oysters "fatten" much more quickly in fresh than in brackish water. Warmth is so favorable to the process that it is said to be sometimes found profitable to warm artificially the water in which the oysters are floated. Although oysters are generally floated in the shell, the same effect may be obtained by adding fresh water to the oysters after they have been taken out of the shell. Oysters lose much of their salty flavor in "floating," and it is a common experience of oystermen that if the "fattened" oysters are left too long on the floats they become "lean" again.

It does not seem probable that the oysters would secure food enough to make appreciable gain in weight in the short time in which they remain in the fresh or brackish water.

It is known that when a solution of salts is separated by a suitable membrane from water containing a lesser quantity of salts in solution that the passage of salts immediately begins from the concentrated to the dilute solution. This is practically the condition which exists when the oyster is transferred from salt to fresh or brackish water. The fleshy portions of the body which are inclosed in a membrane contain salts in solution. As long as the oyster stays in salt water the solution of salts within its body would naturally be in equilibrium with the water outside. When the oyster is brought into fresh or brackish water, i. e., into a more dilute solution, it might be expected that the salts in the more concentrated solution within the body would pass out and a larger amount of fresh water enter and produce such a distention as actually takes place during floating. Careful experiments have shown that this supposition is entirely correct—that is, the oysters actually gain in weight. This is due largely to the fact that they lose mineral matter and gain a considerable amount of water. At the same

time there is a slight loss of nutrients. When in their natural condition oysters contain from one-eighth to one-fifth more nutritive material than when fattened. In the opinion of very many consumers the improvement in appearance and flavor due to the removal of the salts more than compensates for the loss in nutritive value. It seems also to be a matter of common opinion that oysters keep better when part of the salts has been removed by "floating." However, the experiments of the New Jersey Experiment Stations have shown that freshened oysters will not remain alive as long as those taken directly from salt water. Freshening increases very rapidly the rate of weakening and decay (the life period being reduced one-half).

Frequently oysters become more or less green in color. There is a widespread opinion that "greening" is injurious. The color has been attributed to disease, to parasites, and to the presence of copper.

Experiments have shown that quite commonly the green color of American oysters at least is due to the fact that they have fed on green plants of very simple structure which are sometimes found to be abundant in salt or brackish waters. The green coloring matter of the plants is dissolved by the oyster juices and colors the tissues. The opinion of those who have investigated the matter carefully is that such green color is harmless. It may be removed, if desired, by placing the live oysters for a time in water where the green plants are not abundant. In Europe similar green oysters, called "groenbarden" or "Marennes," are especially prized, and to meet the demand oysters are greened by placing them as soon as captured in sea water, where they are kept for months and fed on a species of seaweed which imparts the coloring matter to the gills.

From carefully conducted investigations it appears that in some cases green oysters owe their color to the presence of copper. Such oysters are not generally considered wholesome. Green oysters containing copper differ in appearance from those owing their green tint to vegetable coloring matter, being grass green and not dark green in color and having a verdigris-like slimy secretion on the folds of the mantle. It is said that after the addition of vinegar a steel fork stuck into such oysters becomes coated with copper and that if ammonia is added the oysters become dark blue.

As will be seen by the figures in the table above, fresh and canned abalone correspond quite closely to oyster and clam products similarly prepared. As shown by some tests carried on by Jaffa and Mendel, abalone flesh is especially rich in glycogen. This fact is also emphasized by the figures in the table above, especially those for dried abalone, which are quoted from unpublished analyses made by Jaffa at the California Experiment Station. Generally speaking, compared with other sea products, the abalone is a nutritious food. Its flavor is said, by those who are familiar with it, to be excellent. Large quantities of abalone are canned, the flesh being cut into pieces of suitable

size. Abalone is also dried extensively, the canned and the dried products finding a ready market among the Chinese.

Lobsters, crabs, shrimps, and crawfish are shown by analysis to contain a fairly large percentage of nutrients, as is especially noticeable when the composition of the flesh alone is considered. They resemble the lean rather than the fat fish in composition. Lobsters and crabs are very much alike as regards the structure of the flesh, which in each case consists of coarse dense-walled fibers. Lobsters and similar foods are prized for their delicate flavor. Except in certain regions where they are very abundant and the cost correspondingly low, they must be regarded as delicacies rather than as staple articles of diet. This is, however, a condition entirely apart from their composition. Judged by this alone, they are valuable foods, and may profitably be employed to give variety to the diet.

Although the total amount of turtle and terrapin used in the United States is quite large, the quantity is small as compared with the consumption of such foods as fish proper and oysters. As shown by their composition, turtle and terrapin are nutritious foods, although, under existing conditions, they are expensive delicacies rather than staple and economical articles of diet.

The total amount of frogs consumed per year for food is considerable. As shown by analysis, frogs' legs contain a fairly high percentage of protein. Only the hind legs are commonly eaten. The meat on other portions of the body is edible, although the amount is small, and is eaten in some localities. The prejudice which formerly existed against frogs' legs as a food was doubtless based on their appearance or some similar reason, as they are known to be wholesome.

COST OF PROTEIN AND ENERGY IN FISH AND OTHER FOOD MATERIALS.

As previously stated, the two functions of food are to furnish protein for building and repairing the body and to supply energy for heat and muscular work. Although fish and meats in general may be regarded as sources of protein, they nevertheless furnish considerable energy. Indeed, those containing an abundance of fat supply a large amount of energy—that is, have a high fuel value. If a food contains little protein or energy and is high in price, it is evident that it is really expensive. On the other hand, a food may be high in price but in reality be cheap, if it furnishes a large amount of protein or energy or both. Foods which supply an abundance of protein or energy or both at a reasonable price are evidently of the greatest importance from the standpoint of economy.

In Table 2 is shown how much a pound of protein, or 1,000 calories of energy, would cost when supplied by a number of kinds of fish and other foods at certain prices, and also the amount of total food, protein, and energy which 10 cents' worth of the fish and other food materials would furnish.

TABLE 2.—*Comparative cost of protein and energy as furnished by a number of food materials, at certain prices.*

Kind of food material.	Price per pound.	Cost of 1 pound protein.	Cost of 1,000 calories energy.	Amounts for 10 cents.		
				Total weight of food material.	Protein.	Energy.
	Cents.	*Dollars.*	*Cents.*	*Pounds.*	*Pound.*	*Calories.*
Codfish, whole, fresh	10	0.90	48	1.000	0.111	209
Codfish, steaks	12	.71	36	.833	.142	274
Bluefish	12	1.20	58	.833	.083	172
Halibut	18	1.18	40	.556	.085	253
Codfish, salt	7	.44	23	1.429	.229	437
Mackerel, salt	10	.61	10	1.000	.163	998
Salmon, canned	12	.62	18	.833	.162	547
Oysters (solids, 30 cents quart)	15	2.50	68	.667	.040	147
Oysters (solids, 60 cents quart)	30	5.00	136	.333	.020	74
Lobster	18	3.05	129	.556	.033	77
Beef, sirloin steak	25	1.52	26	.400	.066	380
Beef, sirloin steak	20	1.21	21	.500	.083	475
Beef, round	14	.74	16	.714	.136	615
Beef, stew meat	5	.38	5	2.000	.266	1,862
Beef, dried, chipped	25	.95	33	.400	.106	303
Mutton chops, loin	20	1.48	14	.500	.068	694
Mutton, leg	22	1.46	25	.454	.069	394
Pork, roast, loin	12	.90	10	.833	.112	1,016
Pork, smoked ham	22	1.55	14	.454	.064	729
Milk (7 cents quart)	3½	1.06	11	2.857	.094	891
Milk (6 cents quart)	3	.91	10	3.333	.110	1,040
Wheat flour	3	.26	2	3.333	.380	5,363
Corn meal	2	.22	1	5.000	.460	8,055
Potatoes (90 cents bushel)	1½	.83	5	6.667	.120	2,020
Potatoes (45 cents bushel)	¾	.42	2	13.333	.240	4,040
Cabbage	2½	1.79	21	4.000	.056	484
Corn, canned	10	3.57	23	1.000	.028	444
Apples	1½	5.00	7	6.667	.020	1,420
Bananas	7	8.75	24	1.429	.011	414
Strawberries	7	7.78	42	1.429	.013	240

In the table the prices per pound have been selected from the best data available. It is of course impossible to set any one price which shall represent the cost of these materials per pound in all sections of the country and at all times of the year. It is probable that the prices given represent more nearly those found in the eastern part of the United States than in the southern, central, and western sections, where some food materials are usually somewhat cheaper.

It is to be noted that the cost of 1 pound of protein and 1,000 calories of energy have no direct relation to each other. A pound of protein would be sufficient for a workingman about four days, while 1,000 calories of energy would be less than one-third the amount required per day. By dividing the cost of 1 pound of protein by 4 and multiplying the cost of 1,000 calories of energy by 3.5 results are obtained which show approximately the relative cost of the protein and energy sufficient for one day as furnished by the different food materials. Thus it would take, in round numbers, 25 cents' worth of salt mackerel at 10 cents a pound to furnish one day's supply of protein, while the corresponding energy would require 38 cents' worth. Seven cents' worth of flour would furnish the protein and 5 cents' worth the energy required for one day. It is of course understood that no one food material could furnish the nutrients in their proper proportions for

adults under ordinary conditions of health and activity. The values expressed in the table simply show the relative value from a pecuniary standpoint of the different foods as a source of protein on the one hand and of energy on the other.

It will be seen from the above table that at 25 cents a pound it would take $1.52 worth of sirloin steak to furnish a pound of protein, while the same amount could be obtained in 74 cents' worth of beef round at 14 cents a pound, 71 cents' worth of cod steak at 12 cents a pound, 44 cents' worth of salt cod at 7 cents a pound, or 26 cents' worth of wheat flour at 3 cents a pound. In like manner the cost of 1,000 calories of energy would vary in these same food materials from 36 cents, as furnished by the cod steaks, to 2 cents as furnished by the flour.

It is evident that at the prices given the fruits are the most expensive sources of protein, mollusks and crustaceans next, and the cheaper meats and fish, with the cereals, the least expensive. As regards energy, on the other hand, mollusks and crustaceans are by far the most expensive sources, followed by fish and many kinds of meat, while the cereals are the most economical.

DIGESTIBILITY OF FISH.

The term digestibility, as commonly employed, has several significations. To many persons it conveys the idea that a particular food agrees with the user. It is also very commonly understood to refer to ease or rapidity of digestion. One food is often said to be preferable to another because it is more digestible—i. e., is digested in less time in the stomach, or is apparently digested more readily. A third meaning, and one which is usually understood in scientific treatises on such subjects, refers to the completeness of digestion. For instance, two foods may have the same composition, but, owing to differences in mechanical condition or some other factor, one may be much more completely digestible than the other—that is, give up more material to the body in its passage through the intestinal tract.

The agreement or disagreement of a particular food with any person in normal health is largely a matter of individual peculiarity. When foods habitually disagree with a person, and there is reason to believe that there is pronounced indigestion, the advice of a competent physician is needed, since the nourishment of an abnormal or diseased body is a matter properly included under the practice of medicine.

In so far as ease or rapidity of digestion implies a saving of energy to the body, it may be a matter of importance, especially if the energy expenditure would otherwise be above the normal. However, little is known concerning relative rapidity of digestion within the body. Most of the current statements which refer to this are apparently based on experiments carried on outside the body by methods of artificial digestion. Such experiments imitate as closely as possible the condi-

tions in the body, but it is not at all certain that they are exactly the same. Some experiments with man, which were made a good many years ago, before experimental methods had become fixed, are also often quoted, but it is only fair to say that the popular interpretation of the data recorded does not agree in many respects with that of trained investigators.

The numerous artificial digestion experiments which have been made with fish indicate that it is less quickly digested than beef, being about equal to lamb in this respect. However, as compared with other foods, the difference in the digestibility of fish and meat, as shown by these experiments, is not very great. In some carefully conducted experiments, which were reported only a few years ago by a German investigator, it was noted that oysters, whitefish, and shellfish, taken in moderate amounts, left the stomach in two to three hours, in this respect resembling eggs, milk, white bread, and some other foods. Caviar left the stomach in three to four hours, as did also chicken, lean beef, boiled ham, beefsteak, coarse bread, etc. Salt herring left the stomach in four to five hours, other foods in the same class being smoked tongue, roast beef, roast goose, lentil porridge, and peas porridge. So far as fish is concerned, the general deduction from these experiments was that it is more rapidly digested than meat. With respect to its rapidity of digestion in the stomach, another German investigator includes whitefish in the same class as the following animal foods: Roast chicken, pigeon, roast veal, and cold underdone roast beef.

Before sweeping deductions are made the thoroughness with which fish is digested should also be taken into account. A number of experiments have been made with man to learn how thoroughly fish is digested and to compare it in this respect with other foods. In these experiments the food and feces were analyzed. Deducting the nutritive material excreted in the feces from the total amount consumed in the food showed how much was retained by the body. It was found that fish and lean beef were about equally digestible. In each case about 95 per cent of the total dry matter, 97 per cent of the protein, and over 90 per cent of the fat were retained by the body. Other experiments of the same character indicate that salt fish is less thoroughly digested than fresh fish.

At the Connecticut (Storrs) Station Milner studied the digestibility of fresh (canned) salmon, a typical fat fish, and fresh cod, a typical lean fish, these materials each constituting a considerable part of a simple mixed diet. The calculated coefficients of digestibility of the salmon alone were protein 96.2 per cent and fat 97 per cent, while 85.6 per cent of the energy was available. In the case of the cod the values for protein and fat were 95.9 and 97.4 per cent, respectively, and for energy 80.3 per cent. It has been suggested that fat fish is less thoroughly digested than lean fish, but in these experiments the two sorts were digested on an average with practically the same thoroughness.

A number of similar experiments have been made on the digestibility

of milk, eggs, bread, potatoes, and other animal and vegetable foods. From a large amount of data of this sort some general deductions have been drawn. Thus, it has been calculated that 97 per cent of the protein and 95 per cent of the fat of meats, fish, eggs, dairy products, and the animal food of a mixed diet are digested. Similar values are for the protein of cereals 85 per cent, for the fat 90 per cent, and for the carbohydrates 98 per cent; for the protein, fat, and carbohydrates of vegetables 83, 90, and 95 per cent, respectively, and for the protein, fat, and carbohydrates of the total vegetable food of a mixed diet 84, 90, and 97 per cent. From the available experimental data it also seems probable that leaner meats are more easily digested than those containing more fat, and the leaner kinds of fish, such as cod, haddock, perch, pike, bluefish, etc., are more easily and readily digested than the fatter kinds, as salmon, shad, and mackerel. Generally speaking, it has been found that the protein of vegetable foods as served on the table is less digestible than that of animal foods. For instance, one-fourth or more of the protein of potatoes and beans may escape digestion and thus be useless for nourishment. This is perhaps entirely due to the mechanical condition in which the protein occurs in vegetable foods; that is, it is often inclosed in cells which have hard walls and are not acted upon by the digestive juices. It is ordinarily assumed that the small amount of carbohydrates in meat and fish is entirely digested. Carbohydrates other than fiber, which make up the larger part of the vegetable foods, are very digestible. The fat in both animal and vegetable foods differs in digestibility under varying conditions. No marked difference in the digestibility of the fat in the two classes of food can be pointed out.

Persons differ in respect to the action of foods in the digestive apparatus; and fish, like other food materials, is subject to these influences of persŏnal peculiarity.

The nutritive value of shellfish, as of other fish, depends to a considerable extent upon its digestibility, but information on this point is so limited that but little can be said with certainty here. Perhaps the most that can be said is that while there are people with whom such foods do not always agree, yet oysters belong to the more easily digestible class of foods. In a recently published study of the composition of the oyster and other problems connected with their food value, the statement is made that the nutrients occur largely in forms in which they are readily assimilated, as is shown by the fact that one-half of the crushed oyster and one-fourth of the whole oyster is soluble in water. So far as can be learned no experiments have been made which show how thoroughly clams, crabs, and other crustacea, turtle, and terrapin, and frogs' legs are digested.

PLACE OF FISH IN THE DIET.

The chief uses of fish as food are (1) to furnish an economical source of nitrogenous nutrients and (2) to supply the demand for variety in the diet, which increases with the advance of civilization.

Inspection of a considerable number of dietary studies of families of farmers, mechanics, professional men, and others, carried on in different regions of the United States, shows that about 20 per cent of the total food, 43 per cent of the total protein, and 55 per cent of the total fat of the diet of the average family is obtained from meats, poultry, fish, shellfish, etc., together. Fish, shellfish, etc., alone furnish less than 3 per cent of the total food, less than 4 per cent of the total protein, and less than 1 per cent of the total fat, showing to what a limited extent such food is used in the average household. It is not improbable that in communities where fisheries constitute the principal industry much larger quantities are consumed. It has been found that the laborers employed in the fisheries in Russia consume from 26 to 62 ounces of fish daily. This, with some bread, millet meal, and tea, constitutes the diet throughout the fishing season. These quantities are unusually large, but no bad effects are mentioned as following the diet.

There is a widespread notion that fish contains large proportions of phosphorus, and on that account is particularly valuable as brain food. The percentages of phosphorus in specimens thus far analyzed are not larger than are found in the flesh of other animals used for food. But, even if the flesh be richer in phosphorus, there is no experimental evidence to warrant the assumption that fish is more valuable than meats or other food material for the nourishment of the brain.

The opinion of eminent physiologists is that phosphorus is no more essential to the brain than nitrogen, potassium, or any other element which occurs in its tissues. The value commonly attributed to the phosphorus is based on a popular misconception of statements by one of the early writers on such topics. In discussing the belief that "fish contains certain elements which are adapted in a special manner to renovate the brain and so to support mental labor" a prominent physiologist says, "There is no foundation whatever for this view."

It is well understood that persons in varying conditions of life and occupation require different kinds and quantities of food. For the laboring man doing heavy work the diet must contain a comparatively large amount of the fuel ingredients and enough of the flesh-forming substances to make good the wear and tear of the body. These materials are all present in the flesh of animals, but not in the requisite proportions. Fish and the leaner kinds of meat are deficient in materials which yield heat and muscular power. When, however, fish and meat are supplemented by bread, potatoes, etc., a diet is provided which will supply all the demands of the body. Where fish can be obtained at low cost it may advantageously furnish a considerable portion of the protein required, and under most conditions its use may be profitably extended solely on the plea of variety.

It should be stated that most physiologists regard fish as a particu-

larly desirable food for persons of sedentary habits, because it seems to be less "hearty." While, so far as can be learned, such statements do not depend upon experimental evidence, they are thought to embody the result of experience.

PREPARING FISH FOR THE TABLE.

Fish is prepared for the table in a variety of ways, which are described in detail in books devoted to cookery. A few words, however, may not be inappropriate on the general methods of cooking and possible loss of nutrients involved.

Fish is commonly boiled, steamed, broiled, fried, or baked, or may be combined with other materials in some made dish. When boiled, it is stated that the loss in weight ranges from 5 to 30 per cent. One experimenter gives 26 per cent as the average. This loss is largely made up of water—that is, the cooked fish is much less moist than the raw. Little fat or protein is lost. So far as known, experiments have not been made which show the losses by other methods of cooking. It is, however, probable that there would be usually a very considerable loss of water.

In most cases fat or carbohydrates in the form of butter, flour, or other material are added to fish when cooked, and thus the deficiency in fuel ingredients is made good. Boiled or steamed fish is often accompanied by a rich sauce, made from butter, eggs, etc. Fried fish is cooked in fat, and baked fish is often filled with force meat, and may also be accompanied by a sauce; the force meat being made of bread, butter, etc., contains fat and carbohydrates. In made dishes—chowders, fish pies, salads, etc.—fat and carbohydrates (butter, flour, vegetables, etc.) are combined with fish, the kind and amount varying in the individual cases. Furthermore, in the ordinary household, fish or meat is supplemented by such foods as bread, butter, potatoes, green vegetables, and fruit. That is, by adding materials in cooking and by serving other dishes with the cooked product the protein of the fish is supplemented by the necessary fat and carbohydrates.

DAILY MENUS CONTAINING FISH.

By taking into account the chemical composition of a mixed diet and comparing it with accepted dietary standards it may be seen whether the diet is actually suited to the requirements of the body; that is, whether it supplies sufficient protein and energy and whether it supplies them in the right proportions.

A number of sample menus are given on pages 26 to 28, which show that the desired amounts of protein and energy may be readily supplied by a diet containing a considerable amount of fish. These menus (which are based in part on dietary studies and other food investiga-

tions of this Department covering a wide range and extending over several years) are not intended as formulas for any family to follow, but simply as illustrations of the way in which menus containing the proper proportions of nutrients may be made up. The ingenuity of the housewife and her knowledge of the tastes of the family will suggest the special dishes and combinations suited to her needs. It is not assumed that any housewife will find it convenient to follow exactly the proportions suggested in the menus. The purpose is to show her about what amounts and proportions of food materials would give the required nutrients.

In selecting these menus it has been the object to include such amounts of fish as might be commonly served in an ordinary household and not to provide meals with the largest possible quantity of fish. That the amount which it is possible to introduce in a single meal may be large is shown by the "shore dinners" so common in some regions of New England, or by the famous dinners served at Greenwich on the Thames, with six courses and fish in every course.

With reference to the following menus several points should be borne in mind. The amounts given represent about what would be called for in a family whose demand for food would be equivalent to four full-grown men at light to moderate manual labor, such as machinists, carpenters, mill workers, farmers, truckmen, etc., according to the usually accepted dietary standards. It is ordinarily assumed that an average man in health performing light to moderate muscular work requires per day about 0.25 pound protein and 3,050 calories of energy, the latter being supplied in small part by protein, but mostly by fat and carbohydrates. Men in professional life, performing less muscular work, require smaller amounts. The commonly accepted American dietary standard for such men calls for 0.22 pound protein and 2,700 calories of energy in the daily food. The amount of mineral matter required is not stated, since there is little accurate information available on this point. A diet made up of ordinary foods and supplying the necessary amounts of protein and energy would undoubtedly supply an abundance of mineral matter.

It has been found that women and children consume somewhat less food than men. The assumption is usually made that, provided a woman is engaged in some moderately active occupation, she requires about eight-tenths as much food as a man with a similar amount of work.

In calculating the results of dietary studies (which may be most conveniently expressed in amounts for one man for one day), it is further assumed that a boy 13 to 14 years old and a girl 15 to 16 years old also require about eight-tenths as much food as a man at moderately active muscular labor; a boy of 12 and a girl 13 to 14 years old, about seven-

tenths; a boy 10 to 11 and a girl 10 to 12 years old, about six-tenths; a child 6 to 9 years old, about five-tenths; one 2 to 5, about four-tenths, and an infant under 2 years, about three-tenths.

As previously stated, the quantities in the sample menus are for four men at moderately active muscular work or an equivalent number of men, women, and children. A family might, for example, consist of a mechanic and wife, with four children, two girls of 12 and 6 and two boys of 10 and 8 years, respectively. Here it would be assumed that the man would be engaged at moderately hard manual work. According to the above factors, this family would be equal in food consumption to 4 men at moderate muscular exercise ($1.0+0.8+0.6+0.6+0.5+0.5=4$). In the same way a day laborer's family, consisting of a father and mother with three children under 7 years of age, would be equivalent to 3 men with moderate muscular exercise ($1.0+0.8+0.5+0.4+0.3=3$), and would require three-fourths the quantities indicated in the following menus:

MENU I.—*For family equivalent to four men at light to moderate muscular work.*

Food material.	Amount used.		Protein.	Fuel value.
BREAKFAST.	*Lbs.*	*oz.*	*Pound.*	*Calories.*
Oranges	2	0	0.012	338
Omelet (8 eggs)	1	0	.131	613
Butter for frying	0	1	.001	216
Johnnycake[a]	1	4	.099	1,466
Butter	0	3	.002	647
Coffee	....		.008	248
Total	....		.253	3,528
DINNER.				
Boiled cod, fresh	2	0	.340	658
Hollandaise sauce:				
Butter	0	4	.002	863
Yolks of 2 eggs	0	1¼	.013	135
Lemon juice, etc	....		....	....
Potatoes	2	0	.036	606
Boiled rice[b]	1	8	.018	362
Milk	0	6	.012	117
Sugar	0	3	....	340
Bread	0	12	.069	887
Butter	0	3	.002	647
Total	....		.492	4,615
SUPPER.				
Scalloped oysters:				
Oysters	2	0	.120	442
Crackers	0	4	.027	464
Butter	0	2	.001	431
Milk	0	4	.008	78
French fried potatoes	1	0	.018	303
Lard	0	2	....	505
Bread	0	8	.046	592
Butter	0	2	....	431
Sliced bananas	1	0	.008	290
Sugar	0	3	....	340
Tea	....		.008	248
Total	....		.237	4,124
Total per day	....		.982	12,267
Total for one man	....		.246	3,067

[a] Composition of cooked material from U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.
[b] Composition of cooked material from unpublished data.

MENU II.—*For family equivalent to four men at light to moderate muscular work.*

Food material.	Amount used.		Protein.	Fuel value.
BREAKFAST.				
Codfish creamed:	*Lbs.*	*oz.*	*Pounds.*	*Calories.*
Salt cod	0	8	0.080	153
Milk	1	0	.033	312
Butter	0	1	.001	216
Flour	0	1	.007	101
Baked potatoes[a]	1	12	.044	721
Bread	0	12	.069	887
Butter	0	4	.002	863
Coffee			.008	248
Total			.244	3,501
DINNER.				
Clam soup:				
Clams, round	0	12	.049	158
Milk	1	12	.057	545
Butter	0	$1\frac{1}{2}$	.001	324
Flour	0	1	.007	101
Onion, salt, pepper, etc				
Roast lamb, leg[b]	1	8	.238	1,256
Green peas[c]	1	8	.054	377
Butter	0	2	.001	431
Mashed potatoes[a]	1	8	.039	737
Bread	0	6	.034	444
Butter	0	1	.001	216
Apple tapioca pudding	1	0	.003	541
Total			.484	5,130
SUPPER.				
Lobster salad:				
Lobster meat	1	0	.164	377
Yolks of 3 eggs	0	2	.020	202
Butter or oil	0	3	.002	647
Milk	0	7	.014	137
Sugar	0	1		113
(Vinegar, salt, pepper, mustard)				
Biscuit	0	12	.065	950
Butter	0	4	.003	863
Tea			.008	248
Total			.276	3,537
Total per day			1.004	12,168
Total for one man			.251	3,042

[a] Composition of cooked material from U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.
[b] A larger piece would ordinarily be cooked. The amount given is for one meal.
[c] Weight with pods.

MENU III.—*For family equivalent to four men at light to moderate muscular work.*

Food material.	Amount used.		Protein.	Fuel value.
BREAKFAST.				
Breakfast cereal:	*Lbs.*	*oz.*	*Pounds.*	*Calories.*
Cracked crushed wheat	0	4	0.028	410
Milk	0	6	.012	117
Sugar	0	2		227
Creamed dried beef:				
Dried beef	0	12	.198	568
Milk	0	8	.017	156
Butter	0	1	.001	216
French fried potatoes	1	0	.018	303
Butter (taken up in frying)	0	2	.001	431
Bread	0	12	.069	887
Butter	0	3	.002	647
Coffee			.008	248
Total			.354	4,210

MENU III.—*For family equivalent to four men at light to moderate muscular work*—Con.

Food material.	Amount used.		Protein.	Fuel value.
DINNER.	*Lbs.*	*oz.*	*Pounds.*	*Calories.*
Halibut steak	1	12	0.268	796
Mashed potatoes[a]	2	0	.052	982
Tomatoes (or half amount of parsnips)	2	0	.018	206
Bread	0	12	.069	887
Butter	0	3	.003	647
Apple pie	1	0	.031	1,228
Total			.441	4,746
SUPPER.				
Salmon croquettes:				
Canned salmon[a]	0	8	.098	328
Mashed potatoes[b]	1	0	.026	491
Butter	0	1	.001	216
1 egg	0	2	.016	77
Prune sauce[b]	1	0	.005	418
Muffins	0	12	.065	950
Butter	0	3	.002	647
Tea			.008	248
Total			.221	3,375
Total per pay			1.016	12,331
Total for one man			.254	3,083

[a] Composition of cooked material from U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.
[b] Composition of cooked material from unpublished data.

MENU IV.—*For family equivalent to four men at light to moderate muscular work.*

Food material.	Amount used.		Protein.	Fuel value.
BREAKFAST.	*Lbs.*	*oz.*	*Pound.*	*Calories.*
Breakfast cereal:				
Cracked crushed wheat	0	4	0.028	410
Milk	0	6	.012	117
Sugar	0	2		227
Broiled salt mackerel	1	6	.191	1,524
Boiled potatoes	1	0	.018	303
Hot rolls	0	12	.067	1,017
Butter	0	3	.002	647
Coffee			.008	248
Total			.326	4,493
DINNER.				
Broiled beefsteak	1	8	.248	1,424
Baked potatoes[a]	1	8	.038	618
Onions	2	0	.028	398
Celery	1	0	.009	68
Bread	0	12	.069	887
Butter	0	3	.002	647
Baked apples:				
Apples	1	0	.003	213
Sugar	0	2		227
Milk	0	4	.008	78
Total			.405	4,560
SUPPER.				
Oyster stew:				
1¼ pints oysters	1	4	.075	276
1 pint milk	1	0	.033	312
Butter	0	1	.001	215
Crackers	0	6	.042	716
Bread	0	8	.046	592
Butter	0	2	.001	431
Chocolate layer cake	0	8	.031	801
Tea			.008	248
Total			.237	3,591
Total per day			.968	12,644
Total for one man			.242	3,161

[a] Percentage composition of cooked material from unpublished data.

The weights of fish, meats, and vegetables given in the menus are for these articles as found in the market. The fish and meats will include, as a rule, more or less bone, and the vegetables considerable skin and other parts, which are inedible and are rejected. In estimating the nutrients allowance is made for what has been found to be the average proportion of bone in different cuts of meats. In vegetables it is assumed that from one-sixth to one-fifth will be rejected in preparing them for the table. The weights of the breakfast cereals are for these in the dry condition before cooking.

The values given for tea or coffee are obtained by taking account of the sugar and milk or cream consumed with them. The infusion of tea or coffee contains little, if any, nutritive material. The value of tea and coffee in the diet depends upon their agreeable flavor and mild stimulating properties.

The calculations of the quantities of nutrients contained in the different foods are based upon the average percentage composition of these materials, some of the data being included in the table of composition on page 10, and the remainder in a previous publication of this Office.[a]

The fats and carbohydrates in the different food materials are not shown in the menus, since the quantity of protein and the fuel value of the food are the values which are of special interest. The fuel value of the fats and carbohydrates is, of course, included in the figures for fuel value given.

In the menus only such an amount of each food is indicated as might be completely consumed at each meal. Of course, in the ordinary household usually a rather larger quantity of the different dishes will be prepared than will be consumed at one meal, but the thrifty housekeeper will see to it that what is not used at one meal will be utilized for another.

It is not expected that each meal or the total food of each individual day will have just the amounts of protein and fuel ingredients that make a well-balanced diet. The body is continually storing nutritive materials and using them. It is a repository of nutriment which is being constantly drawn upon and as constantly resupplied. It is not dependent any day upon the food eaten that particular day. Hence an excess one day may be made up by a deficiency the next or vice versa. Healthful nourishment requires simply that the nutrients as a whole during longer or shorter periods should be fitted to the actual needs of the body.

It will be seen that in each of the menus suggested fish occurs in at least two meals. However, in no case is the amount greater than experience has shown may commonly occur in actual dietaries. It is not the intention to suggest that a diet containing such quantities of fish

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.

be followed every day, but rather to show that fish may be readily combined with other food materials to supply the protein and energy required. While it may profitably be used more frequently in many families than is at present the case, the quantity used is a matter to be settled by the demands of individual taste.

The menus attempt to cover, as regards fish and other materials, a range in variety and combination such as might be found in an average well-to-do household. Other dishes, such as fish soups, chowders, fish salads, etc., might have been included also, and would naturally find a place on the table of a family fond of fish and fish products. Individual preferences vary so much that no combination which could be selected would meet them all.

Nothing has been said of the cost of the food used in the menus. All foods vary in price in different localities, and this is especially the case with fish. In general it may be said that a large variety of fruits, green vegetables, etc., if it is necessary to purchase them, increases the cost of a diet out of proportion to the nutritive material furnished. Such foods, however, are valuable, since they possess agreeable flavor and so render the diet appetizing. It is also generally believed that the acids, salts, and similar materials in fruits and vegetables are of value in maintaining the body in health. The income of the purchaser should determine how varied the diet may be.

POSSIBLE DANGERS FROM EATING FISH.

In view of statements of a popular nature which have been made on the dangers from eating poisonous fish or from ptomaines contained in fish, a few words summarizing the actual knowledge on these topics seem desirable.

There are several species of fish which are actually poisonous. Few of them, however, are found in the United States, and the chances of their being offered for sale are very small. Such fish are mostly confined to tropical waters.

Fish may contain parasites, some of which are injurious to man. These are, however, destroyed by the thorough cooking to which fish is usually subjected.

Ptomaines are poisonous bodies due to the action of micro-organisms. They are chemical compounds of definite composition and are elaborated by micro-organisms breaking down the complex ingredients of animal tissues, just as alcohol is due to the action of yeasts breaking down sugar, or as acetic acid is formed from the alcohol of cider or wine by the yeast-like plant which produces vinegar, and which we call mother when we find it collected in masses. The formation of ptomaines quite generally, although not always, accompanies putrefaction (being greatest, it is said, in its early stages), and therefore

great care should be taken to eat fish only when it is in perfectly good condition. Fish which has been frozen and, after thawing, kept for a time before it is cooked, is especially likely to contain injurious ptomaines.

Decomposition can often be recognized by the odor of the fish, especially when it has progressed to any considerable extent. There are laboratory tests for showing decomposition at various stages and for indicating the presence of ptomaines.

In general it may be said that fish should be considered unfit for food when the eyes have lost their sheen, the cornea is somewhat cloudy, the gills pale red, when blubber shows at the gills, when the scales are dry or easily loosened, or when the meat is so soft that if pressed with the finger the indentation remains. Laying fish in water has been recommended as a means of judging of their condition. Those which sink may be considered undecomposed and wholesome, while those which are decomposing will float.

Canned fish should never be allowed to remain long in the can after opening, but should be used at once. There is some possibility of danger from the combined action of the can contents and oxygen of the air upon the lead of the solder or the can itself. Furthermore, canned fish seems peculiarly suited to the growth of micro-organisms when exposed to the air.

Finally, fish offered for sale should be handled in a cleanly manner, and stored and exposed for sale under hygienic conditions.

A kind of poisoning called mytilism, usually very fatal in its results, has been sometimes observed to follow the eating of clams. The reason for this illness is not definitely known, though it is attributed to a poisonous body sometimes found in clams, especially in the liver. Just why this poisonous body occurs is not known, but it is probably due to a disease or some abnormal condition; furthermore, it has been noted that clams from some regions are quite uniformly poisonous. It is said that poisonous clams are less pigmented (lighter with radiate streaks) than wholesome clams, which are uniformly darkly pigmented, and that the shells of the unwholesome clams are more friable and broader, and that the liver is larger, softer, and richer in pigment and fat. A well-known writer on the subject recommends that the public should be warned against buying dead clams—that is, those which do not close the shell when taken out of the water—and that as a further precaution the liver and the broth should not be eaten, if cases of mytilism have recently occurred locally or there is any other reason to suspect the clam supply.

Slight or serious poisoning has also been known to follow the eating of oysters, though fortunately American oysters have been seldom

found to be a cause of such illness. As in the case of clams, the reason for such illness is not definitely known, but it is probably due to the occasional presence in oysters of some poisonous body due to disease or a similar cause. An European investigator reached the conclusion that oysters are generally diseased in the summer months, though the nature of the disease was not learned. He found that the diseased oysters possessed a characteristic milky appearance and that the liver was much enlarged, gray, and soft. It does not seem probable that American oysters are generally diseased during the summer months, as many who live in the oyster-producing regions eat them throughout the year, yet in view of the fact that bad results from eating shellfish are more frequently noticed in the summer than in the cooler months, possibly because they spoil more readily, omitting them from the bill of fare during the summer seems a wise precaution. Oysters dead in the shell or those which are decomposed should under no circumstances be eaten. When removed from the water good oysters close the shell, move when touched, are of normal size and color, and have a clear fluid inside the shell. In the case of oysters dead when taken from the water, the shells remain open, while those which are decomposed are discolored and very soft, have a stale odor, and show a blackish ring on the inside of the shell.

Oyster beds should be free from sewage pollution, and oysters when "floated" or "fattened" should never be placed in water contaminated by sewage. Severe illness and death have resulted in many cases from eating raw oysters contaminated with sewage containing typhoid fever germs.

It is only just to say that the dangers from parasites, micro-organisms, ptomaines, and uncleanly surroundings are not limited to fish. Under conditions which favor the growth of the micro-organisms, meat and other highly nitrogenous animal foods undergo decomposition resulting in the formation of ptomaines. Animal parasites may be acquired from flesh of various kinds if not thoroughly cooked, provided, of course, the flesh is infested. This danger is reduced by proper inspection. Vegetable foods also may become contaminated in various ways. The importance of measures to secure pure and wholesome food can hardly be overstated. The best interests of the people undoubtedly demand a strict and impartial supervision by public officers of the sale of food products.

O